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ABSTRACT

This document describes the agricultural knowledge system (AKS) in Israel, emphasizing the unique features of each of the main subsystems--knowledge policymaking, knowledge generation and knowledge transformation, knowledge exchange and transmission, and knowledge utilization. The following conclusions were reached: (1) in addition to the classic knowledge generation, knowledge exchange, and knowledge utilization subsystems, knowledge policymaking is an important part of the AKS and includes input from knowledge users themselves; (2) the different stages of knowledge generation and exchange are coordinated in an interlocked knowledge management system; (3) knowledge exchange subsystems include the media and farmers, as well as extension agents; (4) a good educational level of users enhances the effectiveness of agricultural knowledge exchange; (5) informal linkages are as important as the formal ones; (6) linkages are especially effective when the AKS is small or when regionalization is well organized; (7) advisors to farmers should be professionals and independent of the government in order to be believed by farmers; and (8) cooperation is an important facilitating factor that enables the user subsystem to have more influence over the system. (A 51-item bibliography concludes the document.) (CML)

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THE AGRICULTURAL KNOWLEDGE SYSTEM IN ISRAEL

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LIST OF CONTENTS

	Page
1. Introduction	3
1.1 The purpose of this paper	3
1.2 The system approach to agricultural knowledge	3
1.3 Some facts on Agriculture in Israel	6
2. The Knowledge User Subsystem ("Farmers")	8
2.1 The main differences among types of villages	8
2.2 Implications for research	10
2.3 Implications for extension	11
2.3.1 - in the Kibbutz	11
2.3.2 - in the Moshav	11
2.3.3 - in the Arab village	12
3. The Knowledge Generation and Transformation Subsystem ("Research and Development")	14
3.1 Origins	14
3.2 The Agricultural Research Organisation	14
3.3 The Faculty of Agriculture	17
3.4 Other academic research institutes engaged in agricultural research	18
3.5 Regional R&D schemes	18
3.5.1 R&D authorities	19
3.5.2 Regional R&D activities by advisers and farmers	22
3.6 Research initiated by commercial firms	23
4. The Knowledge Exchange and Transmission Subsystem ("Extension and Training")	24
4.1 Origins and early developments	24
4.2 Setting up the Extension Administration and Shaham	27

4.3 Shaham (The Extension and Professional Service) 29
4.3.1 The organisational structure 29
4.3.2 Motivation 31
4.3.3 Planning, supervision and evaluation 34
4.4 Other knowledge transmission agents 36
4.4.1 The agricultural press 36
4.4.2 Radio and television 37
4.4.3 Personalized extension outside Shaham 39
4.5 Training 40

5. The Knowledge Policy-Making Subsystem ("Government") 41
5.1 Research policy making and financing 41
5.1.1 The production and marketing boards and the branch directorates 44
5.1.2 Regional councils and farmers' organisations. 46
5.1.3 BARD 47
5.1.4 The planning and financing of field trials. 48
5.2 Planning for the future 49
5.2.1 Planning for research 49
5.2.2 Planning for extension 50

6. What can be learned from this analysis? 52
6.1 The principal conclusions 52
6.2 What can be adapted to other countries? 54

7. Acknowledgements 55

8. References 55

FIGURES

1. Degrees of cooperation in various village types 7
2. Research centres, experimental stations and extension bureaux 15a
3. Organogram of Shaham 29a

THE AGRICULTURAL KNOWLEDGE SYSTEM (AKS) IN ISRAEL

1. INTRODUCTION

1.1 The purpose of this paper

In this paper, I shall describe the agricultural knowledge system (AKS) in Israel as a whole, emphasizing the unique features of each of the main sub-systems - knowledge policy making, knowledge generation and transformation, knowledge exchange and transmission, and knowledge utilization. Such descriptions have been rare, so far. In Israel too, accounts on parts of the system, in institutional terms - e.g. research or extension - have been written; but this paper is the first to attempt to show the workings of the whole as a system. Such case studies are important, because they enable comparative research into the mechanics and dynamics of agricultural knowledge systems (Blum, 1989; Blum, Roling & Engel, 1989).

Before I start to describe the different components of the Israeli AKS, I want to explain why I use in this paper the systems approach towards the AKS, with which some readers might not be familiar . The systems approach, as used in this paper, has helped to identify some important subsystems in the AKS which in the widespread Transfer -of-Technology model ("Research - Extension - Farmer") are overlooked, namely the place of farmers as knowledge generators, the role of the media and of formal education in the transmission of agricultural knowledge and the place of policy making and policy management in the whole AKS (Blum, 1989). Finally, some of the most relevant facts on Agriculture in Israel preceed the detailed analysis of the Israeli AKS. They are intended for those readers who are not familiar with Israeli agriculture.

1.2 The Systems Approach to Agricultural Knowledge.

The Transfer of Technology (TOT) model assumes a linear relation between agricultural research, extension and the farmer, each of which has a distinct and exclusive task. Although Transfer of Technology models pay at least lip service to the need for a two-way flow of information and the importance of feed-back from farmers, these have only recently received more attention in the discussion of the TOT model (Cernea et al., 1985), culminating in the demand for

"putting people first" (Cernea, 1985). However, even after recognizing the important role of the farmer, the TOT model still looks at research, extension and farming mainly as clearly separate organizational units, each of which serves a separate and clearly defined task.

The systems approach to knowledge, which was strongly influenced by Havelock (1969, 1974) has only recently been used to study the flow of agricultural knowledge and, in a wider context, that of agricultural technology (Nagel, 1980; Swanson & Claar, 1983; Lionberger, 1986; Roling, 1988a,b). Its value lies above all in the attention drawn to the cognitive functions - knowledge generation (and transformation), knowledge exchange (and transmission) and knowledge utilization - to name the most conspicuous three. While the TOT model assumes that researchers research and generate new knowledge, extensionists "extend" this knowledge and farmers then utilize it, a systems approach soon shows that this stereotype is misleading in several ways.

Firstly, the division of labour is not as neat as assumed in the Transfer of Technology model. Researchers take an active part in the transmission and in the exchange of knowledge with farmers, when they publish popular articles and participate in farmers' meetings (as they do in Israel). Farmers themselves generate a lot of useful knowledge. They have always done so through the accumulation of experience. Now they are also involved in experiments conducted on their farms and (in Israel) often planned and executed by themselves.

Farmers and agencies besides the extension services play an important role in the exchange of agricultural knowledge, as we shall see in chapter 4. A comparative metastudy (Blum & Azencot, 1989a) has shown that in most countries in which surveys have been conducted, farmers mentioned the experience of other farmers and the mass media, and not the extension services as most important sources for updating their agricultural knowledge. This does not mean that the extension services were not effective. Probably much of the knowledge spread by "contact farmers" and by mass media (the farming press and the electronic media) came to them via extension advisors. However, it shows that the knowledge exchange subsystem is more complex than expressed in the TOT model.

The simple TOT model neglects the role of both general and agricultural education as synergistic factors, enhancing the potential value of newly acquired, agricultural knowledge. Several empirical studies, from Huffmann (1970) to Evenson (1982) have verified the complementarity of schooling and extension in the augmentation of agricultural productivity. In this paper, I shall discuss the importance of formal education in the framework of the agricultural knowledge system.

The simple TOT model ("Research-Extension-Farmer") also neglects the central impact which policy making (or the disastrous effects of its lack) has on the AKS. In fact, policy making should be recognized as another knowledge subsystem. This was done, for instance, in the Interpaks model (Sands, 1988). The task of the policy making subsystem is to define objectives, to set priorities among them and to allocate budgets without which the policy cannot be implemen ted. Policy decision s had and still have an important impact on the contribution of all other subsystems in the AKS. When policy becomes unclear or is misdirected, also the creation, exchange and utilization of agricultural knowledge suffer.

Policy is made by governments and their bureaucracies. It is influenced by those who hold the strings to the purse, either within government or outside. This is also true for the policy making in the context of AKS.

Unlike the other partners in the AKS, policy makers have also to consider the interests of AKS's final user - the consumer. This applies not only to price policies, which are outside AKS. Policy makers have to consider also consumer interests in research and extension, e.g. what priority (and money) to give to research, the aim of which is to discover spray residues on agricultural products. Farmers might not be interested in that. Consumers in cities (who in industrialized countries constitute the majority) might wish extension entomologists to advise them how to fight mosquitoes near city ponds and how to improve their hobby gardening, thus distracting them from working for professional farmers. These examples are taken out of the American reality. In Switzerland, in the Netherlands and perhaps also other countries, extension workers are asked to convey to farmers government policy which is in favour of more environment friendly farming methods, and to convey the government's threat to cut off farm

aid budgets if farmers do not comply with the wish of the policy maker. Thus knowledge policy making should be recognized as an integral and balancing subsystem of AKS.

1.3 Some Facts on Agriculture in Israel

This cannot be the place to describe the various aspects of Israeli agriculture. The following lines are intended to give only the most important data on Israeli agriculture, mainly based on 1986 statistics (State of Israel, 1988; Ministry of Agriculture, 1988).

The land area of Israel is 2,150,100 ha, of which only about 20% (423,600 ha) are cultivated. The rest is mainly desert land, with rainfalls of less than 250 mm per year, all concentrated in the short winter season, or stony hills. Because of the semi-arid conditions rainfed agriculture is hazardous. Over 59% of the cultivated area is irrigated. Water is actually the main restricting factor. A national water carrier (partly open, but mostly consisting of a pipe, 2.74 m in diameter, brings water over 130 km from the Sea of Galilee in the north, which serves as national water reservoir, to the rainpoor southern part of the country. The water quota for agriculture is 1.3 million cubic meters, and it is getting smaller and of poorer quality, every year, because more and more recycled and chlorine rich water has to be used in agriculture. Water quotas are strictly enforced.

Out of a population of 4.5 million people, about 1.4 million are employed, 5% of which in agriculture. The rural population accounts for 13% of the population. Among the 906 rural settlements (1986) 734 belonged to the cooperative sector, namely 412 Moshavim (singular: Moshav), 275 Kibbutzim and 47 Collective Moshavim ("Meshek shitufi"). The latter is similar to a Kibbutz in its production aspects which are collective, but it gives its members a free hand on the consumer side (a trend which is growing also in the Kibbutz movement). In the Moshav, every family manages its farm, but many things are done cooperatively. Fig. 1 schematically shows the main differences between these three cooperative settlement forms.

Fig.1

Degrees of cooperation in various village types (from Blum, 1987)

Village Type	Common (cooperative) Purchase of Inputs and Marketing	Production	Consumption
Kibbutz	+	+	+
Meshek shitufi	+	+	-
Moshav	+	-	-

On the average, in a Kibbutz live 470 people, in a Moshav 355 and in a Meshek shitufi 234. These settlements were established on land acquired by the Jewish National Fund, and it is leased to the farmers on a low interest rate for successive 49 years. Only one son can inherit a Moshav farm.

In Israel there are also 122 traditional Arab villages, in which extended families ("Hamullahs") fulfill some of the roles otherwise played by cooperatives, which were formed only when external circumstances made it necessary, e.g. for the distribution of water (Blum, 1988a). The 50 Jewish "villages" or Moshavot (singular: Moshava) which formally do not belong to the cooperative sector, are very similar to Moshavim, from the point of view of agricultural knowledge exchange.

Close to 60% of the agricultural production, which has a total value of $2,702 million, is from irrigated crops. Some 36% of these crops are exported as fresh produce (not counting processed products like juice). The export of fresh agricultural produce is valued at over $590 million. Together with the export of agricultural inputs and processed products, the total export stemming from the agricultural sector is over $1,500 million or approximately a third of the country's export.

The main crops are those which can be shipped in winter to Europe, and to some extend to other countries in the northern hemisphere. Fruits are still leading, with citrus accounting for 33% of the agricultural export (not including canned products) and avocado for another 14%. However, horticultural crops, usually grown under plastic cover to be shipped during the winter season, e.g. flowers and vegetables, melons and strawberries become more and more important as export products, accounting already for over 29% of the value of the fresh produce export. The introduction of new crops and varieties is very quick, due to the good functioning of the agricultural knowledge system. Cotton, which has an unstable market, takes a 20% share of the agricultural export.

About 40% of the agricultural production value comes from livestock, practically all for consumption in the country. Productivity is high, also in the animal production branches which produce for the local market. Thus, the mean annual milk production per cow is 8,500 kg milk (59% more than in the Netherlands). Due to the lack of pastures, little beef is produced, and this is imported. However, poultry meat and eggs are more popular and the country is self-sufficient.

2. THE KNOWLEDGE USER SUB-SYSTEM ("Farmers")

I shall begin the analysis of the agricultural knowledge system with the component which gives the whole system its raison d'etre - the knowledge users.

Many books have been written on the different types of farming systems in Israel, especially on the Kibbutz, but also to some extend on the Moshav, Meshek shitufi, Moshava (e.g. Weintraub et al.,1969) and on the changes which occured in the traditional Arab villages (Yalan et al., 1972; Arnon & Raviv, 1980). This cannot be the place to analyze them. Therefore I shall only discuss the differences, as far as they relate to the generation, exchange and use of agricultural knowledge in the different farming systems.

2.1 The Main Differences Among Types of Villages

Actually, we can group these village forms into three main types: Kibbutz, Moshav and Arab village. The farming system of the Meshek shitufi is like that

of a Kibbutz with its collective farm, and only the consumer side is similar to that of the Moshav, the cooperative of family farms. In fact, most Meshek shitufi settlements have joined the Kibbutz movement, at least in all aspects concerning farming. The Moshava has fewer cooperative arrangements than the Moshav, but the differences are becoming smaller) and for all practical purposes the knowledge needs and the means of its exchange are the same as in the Moshav. The Arab village has extended families with traditional heads who tend to be rather conservative in the socio-cultural realm.

In all three types of farming systems intensive agrotechnical methods are used by most of the farmers. Where this is not done, the problem is usually a managerial one: the farmer works only part-time on the farm, by his own will or forced by the debts incurred during the recent "agricultural crisis" (which was triggered by problematic financial management, not by lack of agricultural knowledge). There are certainly also cases of lack of contact with the agricultural knowledge system or lack of the means to implement its recommendations, but these are the exceptions.

Kibbutzim, Moshavim and Arab Villages, the three main farming system differ in their farm management, in their differential use of farm machines and labour. (Donkeys, mules and horses have disappeared).

In principle, the Kibbutz receives land according to the planned number of family units; but since all its land is cultivated as one consolidated farm and because it adhers to an ideology according to which it should not employ (and therefore not "exploit") outside labour, the Kibbutz uses heavy machinery. Therefore its members can also cultivate additional, large areas of rainfed wheat, sometimes dozends of kilometers from the Kibbutz, in the semi-arid region in which yields depend on the very uncertain rain patterns. The Kibbutz has practically gone out of most labour-intensive branches like vegetable growing (with the exception of those crops which can be grown "mechanically"). Because of its advantages in the economy of scale the Kibbutz has, practically speaking, a monopoly position in cotton growing. Whenever people in a Moshav decide to grow cotton, they do so collectively, on farm land they pooled together for that purpose.

The Moshav farm with its restricted amount of land, uses mainly the labour of its nuclear family and additional, seasonally hired labour. In the well organized Moshavim pools of implements help to make better use of specialized machinery. Vegetable and flower growing are typical branches of the Moshav, but also of the Arab village. Moshavim are established on national land and each family receives an equal share of land and water, the amount of which depend on local conditions.

The size of (privately owned) farms in Arab villages is more diversified than in the Moshav, but grosso modo it is of the same magnitude. Its relative advantage is the extended family with quite a large number of children who can be "called up" when much hand labour is needed at peak times. For socio-cultural reasons women are not allowed to work outside the village and thus enlarge the agricultural labour force. Thus Arab farmers have gained a dominant position in the strawberry market (for export) and in the production of some vegetable types which demand much manual labour, mainly for picking. Also, Arab farmers still grow some traditional, extensive crops like rainfed olives (mainly for oil), which have been intensified in the Jewish sector (growing table olives). The big disadvantage of Arab farmers is the extreme fragmentation of land, due to the Koranic laws of inheritance. In the past, the lack of cooperatives made the access to irrigation water difficult, because the national water company wants to deal with only one distributer in each village.

2.2 Implications for Research

There are some implications for research and for extension. Research has to cover the crops in which each type of villages is interested, and it has to help to develop (together with industry) machines for both large and smaller farms. It seems that it does meet this obligation also in respect to the weaker sections in the agricultural system. Thus, we find in the tri-annual scientific report of the Institute of Horticulture (Ministry of Agriculture, 1985b) accounts of research on the Syrian olive variety grown in the Arab villages, as well as the introduced cultivars of olives grown mainly by Kibbutzim. Research is done for the whole range of water management, from purely rainfed to fully irrigated. The Department of Productivity Engineering and Systems of the governmental Agricultural Research Organisation designated one of its "areas of

concentration" as "methods, machines and auxiliary equipment for family farms". Also other departments of the Institute of Agricultural Engineering (Ministry of Agriculture, 1985a) are engaged in the development of machines specially built for family farms. Much of the heavy but specialized equipment suitable for large farms are developed in Kibbutz workshops and factories.

2.3 Implications for Extension

Extension too has to take in account the differences between the three main types of farming systems. It has to do so in regards to the organization of visits, specific needs for help and use of methods. In the following paragraphs, I shall give some examples.

2.3.1 - in the Kibbutz

The Kibbutz has its own system of collective decision making. Professional issues are usually decided by the respective Branch Coordinator, typically after discussing them with the other regular branch workers. Therefore advisers usually meet with the Branch Coordinator, often together with his colleagues. Normally, branch coordinators have a good professional background, specializing in their branch and are keen to update themselves. Also social pressure works that way. Branch coordinators (and members of Kibbutzim generally) like to attend courses and seminars. It even gives them a break in their routine. Usually, this does not imply overtime (other than travelling). From these points of view working with branch coordinators in the Kibbutz - the equivalent to specialized farm managers in other countries - is quite gratifying for advisers. The problem is that branch coordinators rotate, often quite frequently, and this necessitates to "start the relation nearly afresh" each time such a rotation takes place.

2.3.2 in the Moshav

The situation is different on family farms, in both the Jewish and the Arabic sector. In both there is continuity in the management of the farm, but the farmer who usually has to divide his attention to different branches cannot specialize to the same degree as Kibbutz branch coordinators. Family farmers also have more difficulties to leave the farm and to attend courses. They bear the full personal responsibity when something goes wrong on the farm and, unlike

the Kibbutz, this will have a direct effect on their standard of living. Also unlike the Kibbutz they do not have a whole system of economic decision making aids to back them up. Therefore it is not surprising that with the deterioration of the economic situation in agriculture, 76% of Moshav farmers and 98% of Arab farmers said that more economic extension is needed. 64% and 81% respectively, expressed a personal need for such advice. So far, the highly specialized advisers discussed with farmers mainly agrotechnical issues, and the relatively few economic specialists of Shaham concentrated mainly on economic problems of the different branches and commodities, devoting less time (and certainly less than in Europe) to analyze with individual family farmers their economic situation and how to improve it.

In some cases, extension advisers have developed special procedures to cope with times of crisis. This was done, for instance, when high fuel prices made rose growing economically problematic and the branch underwent a major crisis. At that time, the advisors categorized growers into four groups: very successful ones, successful ones, those who are "in the red", but not too deep, and those who are heavily in debts and with few chances to overcome the crisis, even with help. Combining insights from emergency medicine with extension experience, the rose advisors decided to concentrate on the third group, namely those who by intensive extension work could be saved, but without it would probably fail. Much was done to strengthen also their morale (even by making a video film for that purpose). Those who still made a reasonable living from rose growing were left aside, for the time being. They could manage alone. However, advisers did visit the (few) very successful growers in order to learn from them. The "lost cases" were advised to leave rose growing and to look for an alternative (with the help of other specialist advisers). So far, Israel has no socio-economic advisory system which could help those in need of an alternative to agriculture to find one - although such a need is growing.

2.3.3 - in the Arab village

Advisors in the Arab sector were faced with specific problems, above all with the lack of cooperative or municipal units which would take upon themselves the task of irrigation water distribution, and the problem of land fragmentation. The regional Arab advisers decided to take up these challenges which were

specific for their sector. Although these tasks were outside Shaham's philosophy of concentrating on "extension only", advisors actively helped to organize water cooperatives and to push the idea of land consolidation, without which no efficient use of the irrigation water could be made and also cultivation and marketing could not be improved.

Differences between types of farmers have to be taken into consideration when choosing the most appropriate extension methods. This was especially necessary during the time many different groups of immigrants had to be integrated (see section 4.1). The different socio-cultural patterns and mentalities made it also necessary to adapt the choice of extension advisors and of extension methods to these groups (Blum, 1987).

The same was done very successful in the Arab villages, thus making it possible to overcome a formerly large lag in agrotechnical development (Arnon & Raviv, 1980; Blum, 1988a). The advisors chosen for the district were born there and knew the mentality of the farmers well, but they had also been exposed to more advanced agricultural technologies, in an agricultural school in which work was considered as important as theoretical studies and/or in the Faculty of Agriculture. They found the balance between following a code of behaviour which is accepted by traditional farmers and taking upon themselves the leadership in introducing necessary and sensible changes. They gained credibility by working hard and not shying away from dirtying their hands, and by introducing on small parts of the farm new and profitable crops with which the old farmers had no experience and, therefore had no inclination to argue in favour of their own past practices. Extension advisors in the Arab sector observed the traditional rules of accepting hospitality, which sometimes included receiving inside information; but they were careful not to get caught between competing Hamullahs, where such a situation existed. Once they had gained the trust of the farmers, they even could advise the women in the field (who do most of the manual work). Especially in the beginning of the extension service (in the 1960s) also the methods had to be adjusted to the traditional preferences, e.g. using rather verbal than written advice, emphasizing the social atmosphere through competitions, social gatherings and organized excursions.

3. THE KNOWLEDGE GENERATION AND TRANSFORMATION SUBSYSTEM ("Research and Development")

3.1 Origins

Israel is quite unique in the sense that the agricultural knowledge generation, transformation, exchange and even utilization subsystems started to develop at about the same time and with planned linkages. While Jews lived in Palestine throughout the centuries (whenever permitted), mainly in the holy cities of Jerusalem, Hebron, Safed and Tiberias, the movement "back to the soil" and to agriculture started only in the late 19th century. Before this idea could be put into practice, the future farmers (who came from the ghettos of Europe or the Old City of Jerusalem) had to be trained in agriculture. Therefore an agricultural school, Miqve Israel, was established in 1870, some years before the establishment of the first Jewish settlement, Petach Tiqva. The first teachers were French agronomists. The school was not only to train future farmers, but also to learn from the experience of "progressive" farmers in the neighbourhood (at that time mainly villages of the German Templar order) and to experiment with new ideas. When the first Jewish settlements were set up, the teachers and graduates of the school started to spread agricultural knowledge among these new farmers.

Still before the first world war, Aron Aronsohn came to Palestine and studied the plants found in his new environment. He found the wild Emmer, one of the progenitors of cultivated wheat, and set up a first experimental farm. The newly gained knowledge was transmitted mainly by way of mouth.

Farmers themselves, coming mainly from Eastern European communities in which learning was highly regarded, were keen to try out new things. Not having any agricultural tradition may have been an advantage for them.

3.2 The Agricultural Research Organisation

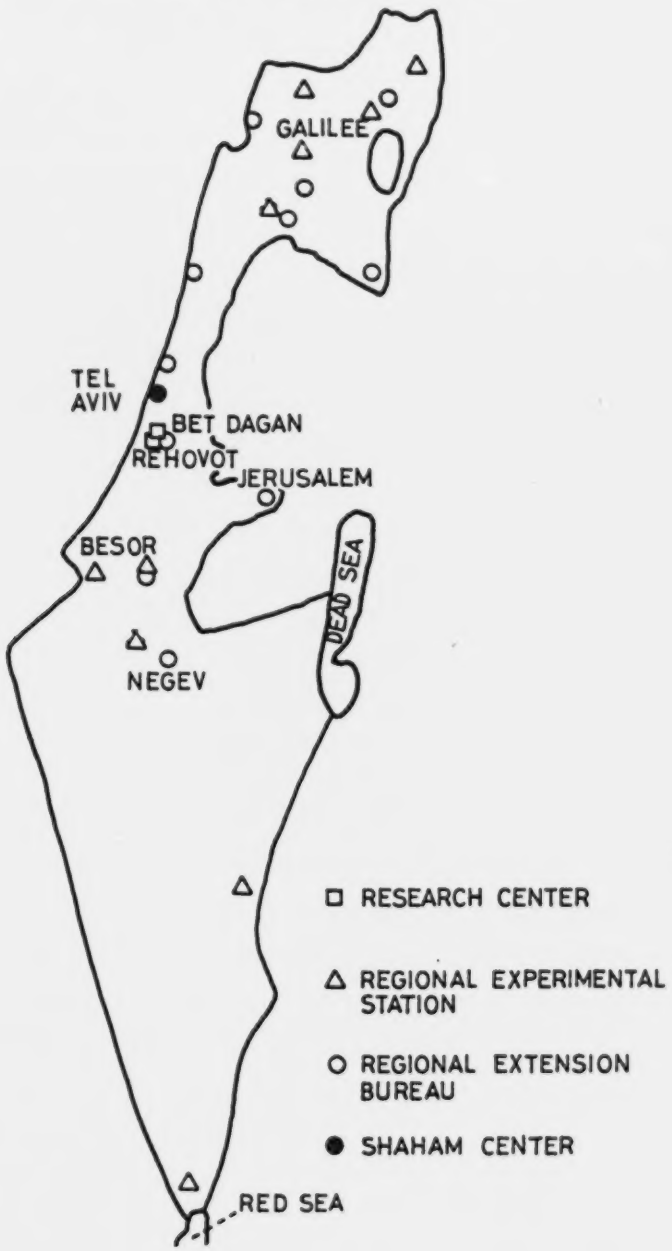
After World War II, the Balfour Declaration and the establishment of the British Mandate over Palestine, a governmental research station was set up at Acre. As a result of relatively simple experimentation, improved varieties of cereals and appropriate recommendations for the use of fertilizers evolved,

improved breeds of farm animals were made available, and new horticultural crop[s were developed. Certified seeds and chicks were produced and distributed to farmers, and advice on insect control was provided (Arnon, 1989). In spite of these efforts, which were directed at very different clienteles - traditional Arab farmers and Jewish settlers - the Zionist movement and the Jewish Agency decided there was a need to establish its own agricultural experimental station. This was accomplished 1921 in Ben Shemen. Its first director was Elazari Volcani. After some years the experimental station was transferred to Rehovot, at the time a center of agriculture. After the establishment of the State of Israel, in 1948, the station was moved to nearby Bet Dagan, and in 1963 it was renamed Volcani Institute of Agricultural Research, after its founder.

Eight years later and following a reshuffle of the research institutions in the country, the institute was consolidated with some smaller ones and became the Agricultural Research Organisation (ARO). Its main campus at Bet Dagan is now known as the Volcani Centre. It has seven institutes: Field and Garden Crops (incl. vegetables and flowers), Horticulture (fruit trees), Animal Science, Soil and Water, Plant Protection, Food Technology and Storage, and Agricultural Engineering. After its manpower was drastically cut, the ARO employs still 1150 persons, of whom some 400 are scientists and agronomists, not counting temporary staff paid for by research funds (State of Israel, 1986). They are involved in about 800 research projects. Besides the Volcani Center, the ARO has eight regional experimental stations of different sizes, including a fish research station. The most important ones are at Neve Yaar (in the north of the country) and at Gilat (in the south). The ARO belongs to the Ministry of Agriculture. Staff are government employees; and the director reports to the Director General of the Ministry.

The ARO director is also Chief Scientist of the Ministry of Agriculture. This double function can become problematic, because ARO researchers are competing with others, e.g. from the Faculty of Agriculture, for research funds which are managed by the ARO itself, in the name of the Ministry. Some 40% of the ARO's 20 Million Dollar annual budget come from such external sources, earmarked for specific research projects and obtained on a competitive basis. (See also chapter 5).

FIG. 2 RESEARCH CENTERS, EXPERIMENTAL STATIONS AND SHAHAM EXTENSION BUREAUX



In principle, the ARO is supposed to concentrate on applied and adaptive research, while the Faculty of Agriculture as teaching institute is assumed to engage mainly in basic research. In reality, the borders are not defined, at all. Basic, biological topics are researched at the Volcani Centre of the ARO, and important biological research techniques have been developed there, when it was assumed that these are necessary to solve bio-agricultural problems, in the long run. On the other side, most of the research done at the Faculty of Agriculture is "applied research" with practical implications (as most agricultural research is anyway, by definition).

The personal promotion of academic staff depends mainly on their publications, but their impact on the advancement of farming is also taken in account.

The institutes of the ARO have also advisory councils with farmers, but since most of these are not active, farmers' and extension advisors' input into the decision making at the institute level is in most cases rather theoretical.

Quite a number of ARO staff teach at the Hebrew University's Faculty of Agriculture regular courses in their field of specialization. They used to get paid as external teachers, but when the Hebrew University run into deep financial troubles and had to drastically cut down manpower, ARO researchers volunteered to give these courses without pay. There are a number of possible motives for their doing so: It is prestigeous to be affiliated with a university; teaching helps to think through professional problems; ARO staff gets so to know bright undergraduates (and vice versa) who might then decide to do their rather extended M.Sc. thesis work at the Volcani Centre, in the framework of research projects. In any case, the close personal link between scientists from an applied research institute and the university with its student body activates also the interfaces between the knowledge generation, transformation and exchange subsystems.

In 1960, an attempt was made to formally amalgamate the Faculty of Agriculture with the ARO. This was not successful, mainly for subjective reasons (personal antagonisms and vested interests), but also because it is difficult to

cope in one administrative unit with such diverse functions as running experimental farms and looking after problems of undergraduate students (Arnon, 1989). However, the libraries of the Faculty of Agriculture and of the ARO were joined. They serve also as National Agricultural Library.

Actually, in the early days of the State of Israel, there was a declared policy to integrate agricultural research , extension and education as much as possible, and a Department of Agricultural Education, Research and Extension was set up. However, over time, agricultural education was transferred to the Ministry of Education and Culture (but remained physically in the compound of the Ministry of Agriculture), and extension and research became quite separated services.

3.3 The Faculty of Agriculture

The Faculty of Agriculture is affiliated to The Hebrew University of Jerusalem, the oldest university in the country, but it is situated on its own campus in Rehovot, some 70 km from Jerusalem, on the site where at its foundation (1942) the Agricultural Experimental Station was. Just over the road is the well known Weizmann Institute, which specializes in basic science. Later the Jewish Agency added next door a Settlement Study Centre which investigates socio-economic developments, mainly in Moshavim. This conglomeration of research institutions, situated one next to the other, give the small city of Rehovot its distinction and even its coat of arms: An orange, a microscope and a book.

The Faculty of Agriculture is the only institution of higher learning in Israel which confers degrees in Agriculture, and the home of the only School of Veterinary Medicine and Nutritional Sciences in the country. It is also known as the Levi Eshkol School of Agriculture. Today it has over 100 faculty members organized in 12 departments (and a Division of External Studies): Agricultural Botany, Agricultural Economics and Management, Agricultural Education and Extension, Animal Sciences, Entomology, Field Crops and Vegetables, Genetics, Horticulture (incl. Ornamental Plants), Plant Pathology and Microbiology, Soil and Water Sciences. The student body consists of some 1600 students enrolled in programmes leading to B.Sc., M.Sc. and Ph.D. degrees, as well as post-graduate Diplomas in (secondary school) Teaching and in Extension.

Of special importance is the fact that about a third of the students come from farms (mainly Kibbutzim and older Moshavim) and go back to farming. Quite a number of the 150 Ph.D. students do their experiments outside the Faculty of Agriculture, often at their place of work, e.g. at a research and development institution, in an agricultural company or even at their Kibbutz)

Research activities cover some 400 projects, ranging from so-called basic to the most applied research topics and techniques. The experimental farm of the Faculty of Agriculture is small - another good reason to experiment under realistic conditions, namely on farmers' fields. Among the interdisciplinary research centres is the Centre for the Study of Semi-Arid Areas and the Warburg Center for Biotechnology.

All faculty members are obliged to engage in both teaching and research. The promotion of academic staff is based on their scientific publications in refereed journals (usually in English). Teaching achievements (for which there are assessments made by both peers and students) and any impact on the agricultural community are recorded, but play a rather minor role in promotion. Nevertheless, the norm is to have good working relations with extension and progressive farmers. However, the Faculty of Agriculture does not direct or control the research projects of its researchers. Therefore it does also not have any central research advisory bodies.

3.4 Other Academic Institutions Engaged in Agricultural Research

Agricultural knowledge is created and adapted also at other academic institutions, although to a lesser degree. The teaching of Agricultural Engineering and Landscape Architecture is done at the Technion in Haifa, the country's leading Institute of Technology. Some of its researchers are also interested in soil and water problems. The young and dynamic Ben Gurion University in Beer Sheba, has a Desert Research Institute in Sde Boqer, in the Negev desert, in which especially problems of arid areas are studied.

3.5 Regional R&D Schemes

There are different types of regional research and development schemes for adaptive research, field trials and field observations, which play an important

role at the interface between research and extension. We have no unified definition for each of these pre-extension activities, as Arnon (1981) has called them . Cotton growers, for instance, differentiate between Follow-up (without repetitions), Planned Observations (with 2-3 repetitions) and full Field Trials (with four repetitions, at least). Since knowledge users participate to varying degrees in these activities, they will be described in more detail in the following sections.

3.5.1 **R&D Authorities.**

In relatively new development areas, especially in the semi-arid Arava and in the Negev (south) regions, as well as in the in the mountainous border regions in the north - in the Upper Galilee and on the Golan heights - joint Research and Development Authorities (usually just called "R&Ds") were set up by the Ministry of Agriculture and the parastatal Jewish Agency. Regional adaptive research directorates function in the Acre, Jordan Valley and Beth Shean regions. So do commodity specific research directorates for Avocado (in Hedera), Citrus (in Raanana) and Cotton (in Bet Shean).

Special attention is now paid to market research, a topic which should become more important in future (Rural Planning and Development Authority, 1987, 1988). This is needed to direct breeders in the right direction. Thus, already in 1976, a market research conducted in Common Market countries showed the potential of growing tomatoes in greenhouses without further heating. However, existing tomato varieties did not combine suitability to these conditions and economic criteria. Therefore a new variety had to be developed, and this took quite some years. Since the lifespan of a new product on the fresh produce market is 5-8 years, R&D efforts are directed mainly at products that are new from the Israeli farmer's point of view, but have a good chance to get into the very competitive export market.

The regional R&D directorates consist of representatives of the Jewish Agency, the governmental research and extension services, Regional Councils and farmers. They are advised by scientific Steering Committees, under the Chief Scientist of the Ministry of Agriculture. In most cases, the Ministry of Agriculture contributes the manpower and the Jewish Agency the operational budget.

R&D funds can be used to contract researchers from one of the universities. Also the Regional Councils come up for part of the cost (Karchi, 1986).

The weight of farmers' participation in the planning, managing and reporting varies from region to region. Where the area is settled for a long time, where farmers have accumulated much experience and are well organized in specialized growers' committees (e.g. in the Upper Galilee and on the Golan heights), their participation and influence is corporate and felt stronger than in relatively new and less well organized regions like in the Arava. In the latter, the development agencies emphasize the entrepreneurial character of individual farmers who contribute to the R&D effort. (Review, 1988). These two examples will be described in some more details, in the following sections.

The "R&D Golan Heights" (or Morag - its acronym in Hebrew) is organized as farmers' cooperative, in which the settlements in the region join forces. It works through growers' committees. Thus, for instance, in the over 200 page long report on its field trials and observations for 1986, the Fruit Growers' Committee (n.d.) mentions six partners: R&D Mountain Agriculture (of the Jewish Agency), the Fruit Growers' Association (of the Agricultural Cooperative Movement), the statutory Fruit Board (which handles production quotas and the research funds accrued from a deduction from all marketed produce), the Golan Regional (Municipal) Council, the Extension and Professional Service (of the Ministry of Agriculture), and the Institute for Research of the Golan. The Editor of the report emphasizes in his introduction that the situation of government supported research and extension has further deteriorated during the last year, and growers had to take over a heavier load of the financial burden. In 1988, they payed for 30% of the budget.

In each agricultural branch, various specialized growers' committees were set up, e.g. in the fruit production branch - expert committees for deciduous fruits, grapes and subtropicals. In these committees, farmers from the settlements belonging to Morag cooperate with regional researchers and advisors in planning experiments. These plans and their budgets are indorsed, once a year, by the settlements (mainly Kibbutzim). Most of the work is expected to be executed by "activists", usually former branch managers of the participating

settlements who serve 2-4 years as coordinators of the growers' committees. This task includes contact with the Ministry of Agriculture, with Production Boards and with farmers' organisations. Morag itself does not engage in economic activities, but some of its developments have lead to the establishment of processing, marketing and exporting cooperatives.

Morag's adaptive research program is very varied. Some examples might give an idea of the scope of the adaptive research field trials, without going into too many details. On apple alone (one of the most important crops of the area) 28 experiments and field trials are conducted on a wide range of topics: suitability of varieties and rootstocks to the local climate and soil, control of tree growth and productivity, fruit thinning, fertigation (meaning the combination between irrigation and fertilizer applications), plant protection (the largest group of experiments), postharvest treatments and storage problems. Other fruit crops are investigated as well, but with a smaller range of experiments (from one to eleven per species).

All these experiments are conducted on two experimental stations and on farmers' fields. The annual report of Magal mentions the names of the researchers in charge and of the (mostly collective) settlements involved.

The Golan Heights Fruit Growers' Committee (n.d.), in collaboration with extension advisers and researchers, also overlooked 28 observation plots planted with 14 fruit crops in 16 different Kibbutz and Moshav settlements, most of them planted during the last two years. Most of these observation plots ranged from a tenth to half a hectare, but in the main crops of the region (apples and nuts) they were larger. The main purpose of these field observations were to record the performance of new varieties and of species which usually grow under different climatic conditions. As a rule, the same combination of crop and purpose of observation is repeted in two or three settlements.

The "R&D" with the largest budget is that of the Arava region. It has two experimental substations, one in a Kibbutz, the other in a Moshav, but most field trials are on farmers' fields. In the nearly 300 page thick report (R&D Arava, 1988), there are accounts on 48 field trials and observation plots. A

clear priority is given to the four most important vegetables of the region. Second priority have new crops with a high potential for the area: mainly different flowers, fruit trees and aquacultural products like algae, fish and frogs, for which there is a high demand on the export market and which can use the brakish water and ample sunshine which are typical for part of the Arava region.

In this case, the investigation teams are mainly made up by in-house agronomists of the R&D Arava, researchers from Ben Gurion University in the Negev, the ARO and the Faculty of Agriculture, regional extension advisers and farmers. (The Arava has probably the highest percentage of farmers with university training among the different agricultural regions in the country). The report of the Rural Planning and Development Authority (1988) mentions that "local entrepreneurs lend important support to R&D activities".

3.5.2. **Regional R&D Activities of Extension Advisers and Farmers.**

In regions in which there are no R&D authorities (with their governmental and Jewish Agency budgets), field trials are planned and executed by extension advisers and farmers' committees, sometimes together, sometimes also each alone. In some regions, were Kibbutzim have a strong interest in research, regional "Research Directorates" were set up for coordination. Funding for these adaptive R&D activities comes from the Branch Directorates, from farmers (through regional councils or directly).

A typical example for the first case is the Lakhish region which was settled in the 1950's. As in the case of the Golan, planning, managing and reporting on experiments is done along commodity lines. In this case the partners were the regional office of the Extension and Professional Service (belonging to the Ministry of Agriculture) and the regional committee of the Fruit Growers' Association (Orchards of Lakhish, 1986). The extension office in the Lakhish region is unique in the way, that it has its own experimental plots and was set up just next to the regional experimental farm of the ARO. Thus researchers, extension advisers and farmers work closely together in the creation and adaptation of agricultural knowledge. The 150 page long report which was prepared in October 1986 for a meeting of the fruit growers, describes some 70 field trials and planned observations on 11 fruit species, emphasizing the

region's most important three crops. The leading partner, in this case of adaptive field research were the regional extension advisors.

In other cases, like in the Galilee, farmers are the leading partner. They organized their own regional R&D - Magal (an acronym for the Hebrew equivalent of Upper Galilee Information). Magal employs 60 people, mostly members of the participating agricultural settlements (predominantly Kibbuzim), a third of which hold a Ph.D. degree.

Granot, an economic conglomerate of over 40 Kibbutzim in the coastal plains with a number of agroindustrial plants, spends annually around a million dollars on adaptive research. They do so mostly, but not always, in line with the ideas of the extension service.

Finally, the picture would be incomplete without mentioning individual farmers' initiatives in setting up trial plots on their fields. Innovative farmers read Hassadeh, the farmers' monthly which is unusual, when compared with farmers' periodicals in other countries, in bringing much more research reports written by scientists of the Faculty of Agriculture and the ARO than marketing reports. Many farmers have the ability and entrepreneurship to adapt research done at the institutes to their own specific situation, thus hoping to gain the commercial advantage of having something novel under their own control, for a year or two. Usually, extension advisors would observe the novelty being tried out.

3.6 Research Initiated by Commercial Firms

The part played by commercial firms in creating and adaptating agricultural knowledge is relatively small, in Israel. The largest agrochemical firm, the government owned Fertilizers and Chemicals Ltd. employs 12 people in its agricultural department, but this figure includes also those with extension tasks. This company has close relations with the extension service.

Private agrochemical firms explore only the formulations and applications of chemicals which come in bulk from outside the country. The local market is too restricted to justify more basic research. In some cases, field staff of commer-

cial firms gave instructions to farmers which contradicted the advice offered by extension, and the latter had to warn farmers that the firms' recommendations were at their own risk.

In the area of irrigation research, practically all development and experimental work is done by the irrigation equipment manufacturers (a large part of them belonging to Kibbuzim). Because they try out new developments on their own fields, with the help of their farmer members, and because they have their own free field service for clients, they could not be closer to farmers' needs.

4. THE KNOLEDGE EXCHANGE AND TRANSMISSION SUBSYSTEM ("Extension and Training")

4.1 Origins and Early Developments

During the Turkish rule over Palestine (until 1918) there was no agricultural knowledge transmission system organized by the state. For the few Jewish settlement there was Miqve Israel agricultural school (see section 3.1) and the French agronomists which were sent over to the young settlements by Baron Rothschild. However, these often behaved like overseers (which they were, in many cases) and therefore arose suspicion.

During the British Mandate (1920-1948), in each District Office there was an Agricultural (and Horticultural) Inspector, aided by Agricultural Assistants. Much of the work was devoted to collecting statistical data and to the supply of chicks, nursery stock, seeds and other propagation materials from experimental stations and from abroad. The inspectors and assistants were also involved in the financial arrangements (loans and grants) under which the farmers received the goods. Helped by the village headman (the Mukhtar), they set up the lists of the farmers entitled to receive the goods. The agricultural assistants collected the money and deposited it daily at the district office (Blum, 1988a)

Work was planned according to weekly schedules. Extension was not a top priority, but Agricultural and Horticultural Officers gave lectures, and the Agricultural Inspectors held meetings in the villages, mainly to persuade farmers to introduce new varieties of crops which they had grown before. The

written, monthly reports were deemed to be important. Estimating crops by the agricultural inspectors was quite liked by the farmers. It did not "hurt", because it served only for statistics. Thus, friendly contacts were kept between the government officials and the Fellahs, who sometimes would also slaughter a lamb in honor of their influential guests.

These restricted extension activities were geared mainly towards the Arab Fellah population which at that time had neither access to an agricultural school nor to other sources of agricultural knowledge except experience.

In the Jewish settlements much attention was given to the local creation and transmission of agricultural knowledge. Going back to the soil and to agriculture was a central motto in the Zionist pioneering movement which started early in the century and gained momentum after the Balfour Declaration and the establishment of the Mandate. Learning was a tradition, and the revolutionary spirit directed learning from the traditionally religious subjects to those connected with the redemption of the land. Members of the settlements who had more agricultural knowledge than others went from settlement to settlement, often on foot or on a donkey, and lectured in the evenings. Meetings were held, courses were organized and agricultural periodicals and books were published by the Growers' Associations which belong to the Agricultural Center of the Settlement Movement.

Some Jewish agronomists worked in the Government service, mainly as Horticultural Officers. Others were employed by the Settlement Department of the Jewish Agency. When this set up the Experimental Station at Ben Shemen, which was later transferred to Rehovot, one of the tasks of the researchers working there was to go around the settlements and to discuss the agricultural news at meetings which lasted sometimes until deep into the night. The researchers-advisers had a strong feeling of belonging to the same idealistic group of "redeemers of the land".

After the establishment of the State of Israel, in 1948, a Ministry of Agriculture was set up, at first quite along the British tradition, with regional agricultural and development officers. The emphasis on plant protection

was continued. Advice was mainly given to farmers who brought plants with signs of diseases to the office. However, also a Professional Center was established at the Ministry of Agriculture headquarters whose main task was to collect and transmit agricultural knowledge. It cooperated in this task with the experimental stations. The staff of the Ministry of Agriculture was quite able to serve the established Kibbutzim and Moshavim and to back-up the general advisers in the new settlements.

The first decade after the establishment of the State of Israel, 1948-57, was one of tremendous development in the Jewish sector. A flood of new immigrants reached the shores, mainly remnants of the holocaust in Europe and refugees from Arab countries in North Africa and the Near East. Within a few years the population of the country doubled and 400 new settlements were established, 250 of them by new immigrants. These did not like the idealistic Kibbutz in which not only production, but also consumption is organized collectively. They preferred the lesser degree of agricultural cooperation in the form of a Moshav. They had no farming background, they did not know the language of the country, Hebrew, and many could neither read nor write - in any language.

To introduce these refugees to farming demanded an extraordinary and new approach to extension. Volunteers with practical experience were recruited by the Jewish Agency. Usually a couple from an established Moshav came to live with the new immigrants in their new village. The husband worked as agricultural advisor, his wife did the same in home economics and both helped the newcomers also to find their way in the new environment. The extension worker went from farm to farm, on a regular pattern (in order to prevent the impression that he does more for one than for others). Living together with the farmers and serving as personal example was the best way of extension. However, it was only possible because of the voluntary and idealistic behaviour of these extension workers called "guides", a name which was never changed, also when the extension workers felt they had become advisers rather than guides.

During that time, extension workers of the Jewish Agency had no academic training in agriculture. Most had ten or eleven years of schooling, often without any formal, agricultural education. They learned about new crops and

practices while on the job. This in-service training was compulsory. (Thus, some of the major elements of the Training and Visit approach to extension, namely constant training and frequent contacts with adaptive research, regular contact with farmers in the field, no office work and formal reports,- were already present in the extension service of that period, but without the later formalization).

A few insights were gained at that time. One was the importance of working with traditional leaders, which was in our case especially important, because the new settlers came from so many different cultural backgrounds. At that time also sociologists joined the extension service and backstopped the extension workers who had no methodological training.

Extension in the immigrant settlements was also adapted to the cultural patterns of the ethnic sub-cultures. Yemenites, for instance, could read a page upside down. When they studied the Bible in Yemen, they did not have enough books (but lots of motivation to read), so that a group of pupils had to study, standing around one book. These people took quickly to reading agricultural pamphlets. Other groups, like those coming from Kurdistan, were predominantly illiterate and had a verbal tradition. Therefore the best way to approach them was verbally.

4.2 Setting up the Extension Administration and Shaham

In 1955, the Ministry of Agriculture and the Jewish Agency established a Joint Extension Center to coordinate their extension work. Its main strength was in the extension training activities and in the publications which became more adapted to the needs of the majority of (new) farmers. Also the cornerstone for the production of audiovisuals were laid at the time and extension methods were further developed. Most of the work was directed towards the new immigrant settlements. However, in many cases duplications of work done by the two separate services continued.

The first Agricultural Extension region for well established settlements was set up in January 1958, in the Hula Valley. It served as pilot region. In the

following year three more regional offices were established (Hayes, 1962), but they functioned only for a few months, as interim solution.

The breakthrough came 1960, when Moshe Dayan, then Minister of Agriculture, started the unification of the extension services. First, those of the Ministry of Agriculture and of the Jewish Agency were linked and a joint Extension Administration was formed. By that time, the farmers in the "new" settlements (as they are sometimes called even today) had reached an agricultural knowledge standard which was compatible with that of the old Kibbutzim and Moshavim.

Dayan and the new Director of Extension wanted extension to be as close as possible to the farmers. Therefore, extension was decentralized and 13 regional bureaux were set up during the next twelve months. Later they were consolidated into 10 regions. The advisers in the regional bureaux were to be backed up by experts from the Tel Aviv headquarters of the service. Until 1965, the Professional Center and the Extension Administration in the Ministry of Agriculture were seperate units. The idea was to separate the statutory tasks of the professional division from the extension activities.

Until 1965, the Growers' Associations continued to offer extension services to their members, mainly because they feared that the Ministry of Agriculture would prefer its own interests over those of the farmers. This was probably a left-over from the Mandate time, when the government was viewed as colonial and not serving the interests of the Jewish farmers who had to set up their own extension scheme. After some years, also the growers realized that they had now their own, independent government which happened to be ruled by the same party to which the large majority of the farmers belonged.

Early in 1965, the Extension Administration came under the sole direction of the Ministry of Agriculture. Since in the meantime Israeli agriculture had become more specialized and a closer link between professionalism and extension work was needed, the Extension Administration and the Professional Center were fused to form the Extension and Professional Service (acronymed Shaham). Growers' Associations continued to publish periodicals, but stopped doing direct advisory work. However, the Cotton Growers' Association (one of the strongest)

employs mainly seasonal plant protection inspectors who fulfill para-extension tasks. Also, advisors employed by the Jewish Agency continue until now to assist young settlements in the establishment of Citrus and other fruit plantations, until these bear fruit.

4.3 Shaham (The Extension and Professional Service)

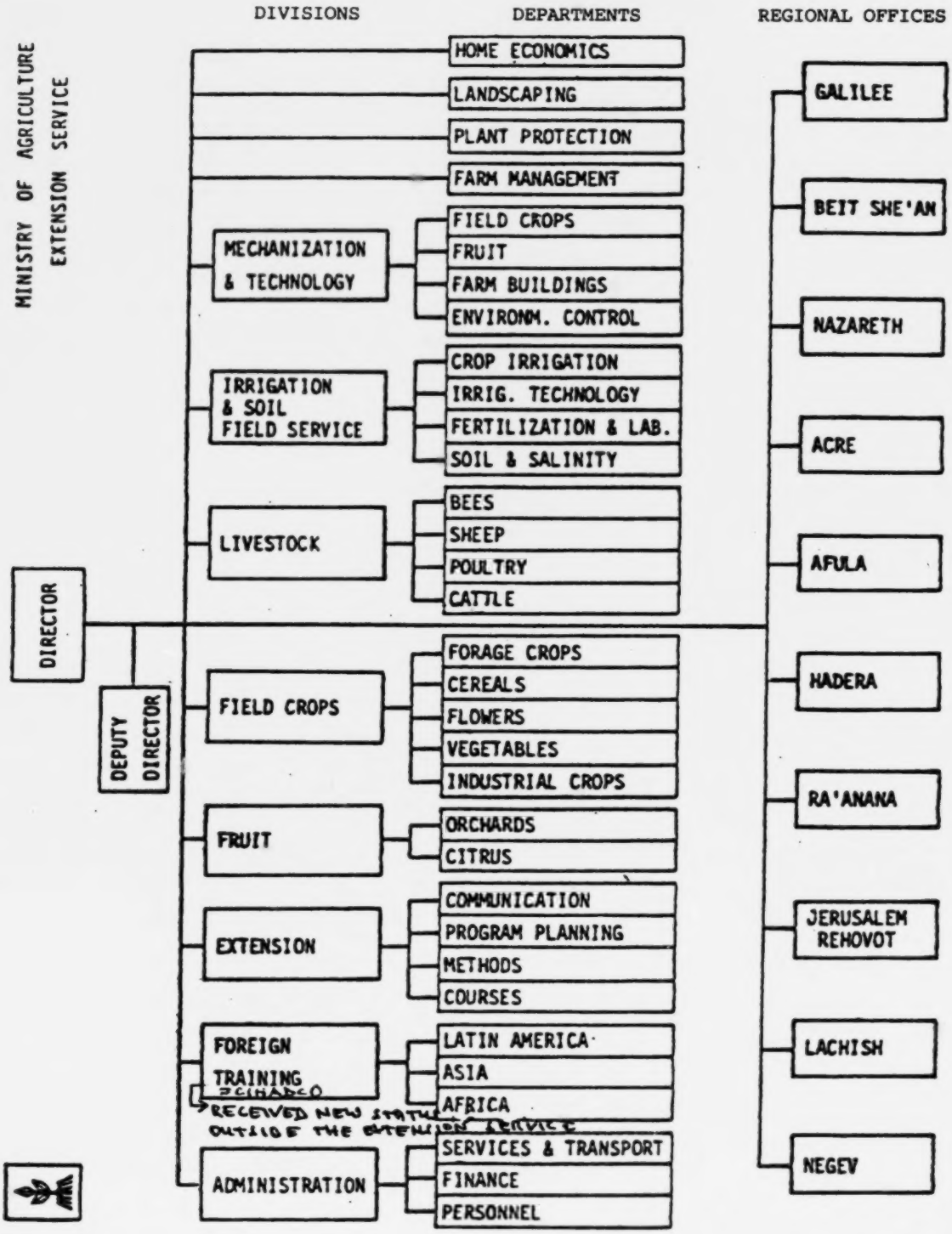
4.3.1 The Organisational Structure

Shaham is the public extension service which serves all sections of the farming community. It has a a double set-up: a professional structure (which is considered to be the main one) and regional bureaux for administrative and logistic purposes (see Fig.3). All advisers are specialists and belong to a professional or subject matter department. These are organized according to agricultural branches or commodities (cereals, industrial crops, vegetables, orchards, citrus, flowers, cattle, poultry etc) or services (plant protection, farm management, mechanization, soil and irrigation field service). There are also parallel departments for extension methodology, extension planning, preparation of audio-visuals and the like, and administrative units.

Every department is headed by a director who is an experienced professional in that specific area. Advisers who belong to a specific subject matter department meet regularly, usually once a month and discuss all professional issues. When a subject area becomes diversified, special subgroups are formed which devote their attention to their area of specialization, under the guidance of a Chief Professional Extensionist (CPE). Thus, in the Plant Protection Department or in the Economics Department there would be CPEs for vegetables, flowers, fruits etc. Other advisors could become specialists for plant protection in floriculture or in arboriculture and so on. Depending on the relative importance of each branch and of the need to specialize to this level, such interdisciplinary specialists would have a national or a regional respopnsibility.

Whenever two or more specialists from the same professional branch work in one regional bureau, they form a "cell" and divide the work among themselves. They either geographically subdivide the region (especially when it is quite large) or each assumes an even more specialized assignment (e.g. in milk

Fig.3
ORGANOGRAM OF SHAHAM



production: one will concentrate on feeding problems, the second on buildings, the third on management) - similar to the national CPEs, but at the regional level.

Each regional extension bureau has an advisory Technical Committee in which farmers participate. These committees are sometimes quite active, sometimes dormant, depending on the extension and farmer personalities involed in each region.

So far, Shaham is the biggest unit in the Ministry of Agriculture with its own budget. It offers free services. An exception is the Field Service which advices on soil, irrigation and fertilisation questions. It has its own regional laboratories for soil and leaf tests and is financed half by Shaham and half by the farmers and municipal units in the region. Modest fees are paid for soil and leaf tests.

Until recently, Shaham had some 600 advisers, of which about 450 worked in the regions and 150 were based at headquarters (but spent much time in the field). Due to manpower cutbacks in the governmental services, Shaham's staff shrank to about 350, of whom about 100 work in the centre and the other 250 in the regional bureaux. This is still quite a lot for 50,000 farmers. In reality, one advisor can have contact with more than 200 farmers. Because of the high specialization, a farmer might be advised by more than one advisor, if he has several branches on his farm or if he needs an interdisciplinary specialist to look after a specific problem.

Shaham's regional bureaux were headed until recently by Regional Directors of Extension, which were assisted in their mainly organisational and administrative jobs by an Extension Coordinator and a secretary. The regional bureaux organize group functions like field days, one day seminars and courses (as far as these are not organized on a country-wide basis). They serve also as logistic base for the regional advisers, printing and dispatching the leaflets they prepare for their clients.

Recently, the 25 year old separation between Shaham's regional bureaux and the Regional Offices of the Ministry of Agriculture, which has mainly planning and statutory functions, was ended. This was done for efficiency reasons. In most regions both offices were anyway in the same building. Shaham as such was left intact, mainly as a professional body (until its future will be decided in talks between the Ministries of Agriculture and Finance and Farmers' Organisations). Another reason for the fusion of the offices was the wish of the Ministry's Director General to have direct control over the regional extension bureaux (and not only through the national Director of Extension). Shaham staff did not like the fusion at all, mainly fearing that they might have to take up also statutory, regulating or supervisory functions, which might destroy some of the trust farmers had in them. So far this has not happened.

When the posts of the new Regional Directors of the Ministry of Agriculture were advertised, in all regions former directors or other staff from the regional Ministry of Agriculture (planning) offices and not directors of regional Shaham bureaux were chosen as the new "overall" heads of the unified region. This was at least partly connected with the fact that all regional Shaham directors' (with the exception of Nazareth, where the new post was not yet advertised) lacked academic qualifications - quite unlike Shaham's professional staff who during the last 25 years had graded themselves up, academically.

4.3.2 Motivation

At least until recently (before the uncertainty over the fate of Shaham started) advisers were known to be highly motivated and hard working people. They certainly did not behave like stereotyped government employees. In spite of the relatively low pay, many of the best advisers remained with the service, although they could find a higer income in private industry. There are not many possibilities of promotion in the system. Positions of Regional Extension Director or of Departmental Directors in the centre become seldom vacant and do not offer much of a rise in salary or prestige. How, then, can we explain the high motivation (which so often is a problem in many extension services, especially in developing countries)?

A number of factors contributed to this state of affairs. Extension advisors always saw themselves as professionals and were highly esteemed by the farming community. Both groups appreciated the central part which extension played in the development of the country, especially when agriculture was the backbone of the national economy. (It is still the most important exporter, after cut diamonds). Most advisers felt themselves as pioneers who fulfilled an important mission. Social approval became an important incentive. It worked especially well in a relatively small system in which everyone knew everyone else

The other aspect of professionalism was the constant upgrading of knowledge, both formally and informally. When the Extension Administration was set up, there were few advisers with university training. They were especially rare among those working in new immigrant villages. This had to change when agricultural overproduction made it necessary to shift production towards the export market. Europe (and later other parts of the world) were ready to pay for the high transport costs of air lifted vegetables, fruits and flowers, if these came at the right time of scarcity on the market and were of high quality. Thus a change from all-round-farming to specialization was necessary. The demands on advisors' specialist knowledge grew quickly, and an intensive upgrading process began. Extension workers were released part- and even full-time (without loss of salary) to study at the Faculty of Agriculture. Today, two thirds of extension advisers hold at least a B.Sc. degree, and new advisors often hold an M.Sc. degree or work for one, after some years of experience, encouraged by the extension service. This means that they have done empirical research - a condition for thesis work at the Faculty of Agriculture. This enables them also to take an active part in knowledge creation and to be considered serious partners by their colleagues in research. As always, exaggerations can be observed, and farmers have complained about advisers who have become too involved in research, neglecting their visits to farmers. However, these are the exceptions.

Informal knowledge updating and creation is not less appreciated in the extension system. Advisers are expected to spend <u>at least</u> one day per week "filling up the battery" by reading, attending courses, meeting researchers and conducting field trials. The service helps outstanding extensionists to find

funds for professional journeys abroad. An anecdote which I heard from the man who was longer than any other a Director and later a Minister of Agriculture may illustrate this point. One day a successful adviser came to him to ask for financial help to travel to Japan, because he had heard that there interesting things go on. The Minister gave him the opportunity, under one condition: instead of writing a report on the visit, he should come back with at least one practical suggestion. The extensionist came back with knowledge about covering plants during the cool season with plastic - a technique which completely revolutionized Israeli agriculture.

Another powerful incentive which is not connected with higher pay is the "position" of Referent. An adviser, even a relative junior one who has shown initiative can become referent for a new crop or for a special problem. He is released from part of his routine duties in his region (without any change in the statute book) in order to become number one in the new area of specialization. He will read all about this new crop or topic, he will meet with the researchers involved, he will visit any place in which experiments were conducted and he might even travel abroad for that purpose. This gives him the feeling to be THE expert on the topic. If this will turn into a new and expanding agricultural branch, he might become CPE. Should the idea prove to be unpractical, he can go back to his former duties and take up another specific challenge.

This dynamic system of specialization, which assumes that one has to be always on the lookout for new knowledge developments greatly helped, when new agricultural branches developed within a short time. The most conspicuous case was the development of knowledge rich floriculture. When a quite sudden demand for advisors in this new branch arose, advisors who had their main training in other plant production fields could be retraines within a relatively short time, due to (1) their well founded basis in plant biology and plant production principles which they had obtained during their studies at the Faculty of Agriculture, (2) the philosophy of the extension system, which expected and welcomed pioneering in new subject matter areas, and (3) the readiness of the advisors to venture into new fields, knowing that this would also add to their personal prestige.

4.3.3 Planning, Supervision and Evaluation

Planning is done consecutively at three levels: at the national policy planning level, at the branch level (mainly nationally, with regional indications), and at the personal (and cell) level.

First, the Professional Directorate of the Ministry of Agriculture defines its priorities in form of Trend statements. These are usually planned for a longer period, taking in account the five year plans; but they are reviewed every year. Then each Branch Directorate (see section 5.1.1) will choose those trends which are most relevant to its branch and will formulate more operational Work Objectives. In the third stage, each extension adviser is expected to plan his own Personal Work Plan, which is to be discussed with colleagues in his cell (if there is one in the region). The first two steps are documentated in a brochure released annually by the national extension director.

The 1988/89 document (Work Objectives, 1988) includes 43 specific Trends (not all of them relevant to extension). They are grouped into eight areas: agrotechnical research and development; market research and sales promotion; economics and system organisation; expansion of production to relieve imports, enhancement of the productivity of water, using water of low quality; development of the family farm and its adjustment to changing conditions; optimalization of the use of production means through enhancement of professional levels; enhancement of the professional level of Ministry of Agriculture personnel and its interdepartmental coordination.

Obviously, not all these trends are relevant for the extension service. Therefore, the extension director summarized the service's priorities in two organizational goals which are to be extension's answer to organizational changes forced on it: (1) enhancement of the links with other parts of the Ministry; (2) building up new and binding frameworks with the farmers. Then follow three professional goals: (1) continuation of the development and implementation of new ideas, in order to enhance farmers' net income and their professional level; (2) enhancement of the per unit net income of farmers' production means, thus enabling them to live off a small area of land and a limited amount of water; and (3) help and guidance to new organisations in the

agricultural system, thus helping agriculture at least a little to overcome its present crisis.

The main part of the planning brochure contains the Work Objectives in the realms of extension and professional development of 17 branches (including services and the extension division). These branches are more or less identical with the departments in Shaham. The Work Objectives of the different branches indicate often (but not in all branches) one or more of the following parameters:

(1) who should work towards the implementation of the objectives (all regions or only specific ones);

(2) what is the priority rating of the objective (usually using three categories);

(3) and more seldom: what should be the scope of the objective (on how many hectares should the innovation be implemented, how many field trials should be set up, etc).

The "branch" with the largest number of objectives (75), but without setting any priorities or quantitative specifications is the extension division which has as one of its objectives - the development of Work Objectives.

The Personal Work Plans seem to be the Achilles heel in the planning of the extension programmes, although they are practically the only tool by which the advisers can evaluate at the end of the year how far they have achieved the objectives set by themselves. Most extension advisers hate paper work and do not see the importance of a written plan, which "in any case is only the base for changes". Many argue for "being left free to respond to changing needs." Recognizing the reluctance of advisers to formulate their annual, personal work plans, the director suggested in his introduction to the Work Objectives to simplify and improve the format of the personal work plans.

Shaham does not have any formal supervision or evaluation procedures. Advisers are seen, and see themselves, as professionals. The system is small and its heads know each of the advisers and probably have met them in the field and received feedback from colleagues and farmers. The heads of Shaham visit each

regional office at more or less regular intervals, mainly to discuss the problems of the region and what the regional advisers are going to do about them. While outstanding advisers who are candidates for promotion can be easily detected, cases of lack of initiative or unorderly work are more difficult to detect and to correct. When the internal standards were very high, the social pressure within the group was apparently strong enough to deal with these cases. With a deterioration of the morale, more complaints are heard.

There is also no formal procedure for the evaluation of the work of departments and other organisational units. While this lack of evaluation is typical of most public extension systems which have a monopolistic position, it is missing when achievements should be demonstrated to the policy level and to outside critique.

Recently, the first impact evaluations were made by an independent unit, the Department of Agricultural Education and Extension of the Faculty of Agriculture. It was restricted to the contact between extension and Moshav farmers in the (Jewish) Rehovot region and family farmers in the (Arab) Nazareth region. Partial data on the impact of extension on farmers were also obtained in studies on the decision making behaviour of tomato and rose growers and on the use of infrared aerial photography as extension tool in cotton and citrus growing. The main findings on the utilisation of the knowledge transmitting system by farmers and their own contribution to the dissemination of agricultural knowledge will be discussed in chapter 6.

4.4 Other Knowledge Transmission Agents

4.4.1 The Agricultural Press

Actually, Israel is one of the few countries in which research has shown that the high rate of contact with advisers is the main channel for the transmission of innovations and advice on how to solve practical problems. The farmers' press is the runner-up (Blum & Azencot, 1989a). In larger industrialized countries, e.g. Canada, the U.K. and the U.S.A the farming press was found to come in first place (Blackburn, 1972, 1981, 1984, 1987; Farmers' Sources, 1980; Forest & Marshall, 1977). The most popular farmers' monthly in Israel is "Hassadeh", which is published since 1921 by the Agricultural Center

of the settlement movement on a commercial basis. Its 200-250 thick monthly issues are organized according to branches and contain regularly reports on formal research, on field trials and experiences of farmers. It is read (at least partially) by practically all responsibles of agricultural branches in the Kibbutzim and by 75% of Moshav farmers; about half of them read it regularly (Blum & Azencot, 1989b). Since much applied research is reported by the investigators in Hassadeh, parallel to the publication of the results in an international scientific journal, innovaters among farmers sometimes adapt the research results immediately to their own situation and try them out in their own field, without waiting for someone else to do the adaptation for them. These trials would usually be observed by extension advisors.

Shaham advisors send pamphlets and postcards to their clients, when short term information has to be spread. These pamphlets are usually mimeographed at a regional extension bureau and are mailed according to address lists. However, these are not always updated and especially new entrants into a branch suffer from a communication gap. The pamphlets are usually rated as very helpful by farmers (Blum & Azencot, 1989b). Brochures on more basic topics, and those which have a validity span of more than one season are published by the extension headquarters. Their availability and speed of updating depend on the willingness of advisors to spend time on this job. The distribution of brochures lacks behind that of the pamphlets, mainly because farmers have to order them from Shaham headquarters or buy them at a regional bureau and cannot subscribe to them on a regular basis. Farmers would prefer the latter and are ready to pay.

The publications of the different Growers' Associations are of importance to their members who specialize in the specific branch. They tend to emphasize problems encountered in Kibbutz farming systems.

4.4.2 Radio and Television

As in most other industrialized countries, radio and television play a minor role in the transmission of agricultural knowledge. In the research on Moshav farmers in the Rehovot region (Blum & Azencot, 1989a), television was found to be the more attractive of the two. This was more surprising for Israel, where the Extension Service devotes more efforts to radio programmes than to

television. Short, agricultural radio programmes are broadcast daily in Hebrew, the language spoken by Moshav farmers, but the eight to ten minutes long programmes are scheduled at 6.20 in the morning. Israeli Television, which so far has only one channel, broadcasts only once a week a half hourly agricultural programme, in the late afternoon, and only in Arabic, with Hebrew subtitles (unless interviews are in Hebrew and then the subtitles are in Arabic). The agricultural programmes were included in the Arab speaking part of the television programmes because of the higher percentage of farmers in the Arab population. In both television and radio programmes, the main contribution comes from advisers of the Extension Service. The radio programmes are actually fully controlled by the Extension Service, but also the television programmes are strongly influenced by extensionists as producers or advisers.

Why, then, do Hebrew speaking Moshav farmers consider agricultural television programmes in Arabic as more useful source of information than radio? The answer has to be sought in the smaller number of farmers who listen to the radio programme, compared to the number of those who watch the agricultural telecast. Although the mean rating by users was similar for both types of broadcasts, only 7% of the respondents rated the radio as very useful source of information, but more than twice as many (17%) gave this rating to television, although this medium reaches them only once a week, even not in their own language, and not daily like the Hebrew radio broadcasts. The preference for television, in spite of these handicaps, can be explained by a number of facts. The visual, colourful medium in itself is more attractive; the hours of broadcasting, after work, are preferred; many farmers open the television set nearly automatically when relaxing after their work; television programmes are longer and can deal with a topic in more depth; and part of the concise radio information reaches farmers also through the leaflets of the Extension Service and thus loose their news value.

Of course, the use of one information medium by farmers does not cancel out the use of others. Actually, the correlation between watching television and listening to the radio was $r=0.45$, one of the highest correlation coefficients found in the study. Many of those who listen to the agricultural broadcasts on the radio also watch agricultural television, but not vica versa. Recently the

radio programmes (for which Shaham had to pay as advertisement!) have been stopped, due to financial constraints.

After the introduction of a teletext service into the Israeli television system, Shaham took upon itself the preparation and the updating of the agricultural teletext items, which cover some 30 frames. Plant protection items are updated twice a week, prices on the export market once a week.

4.4.3 Personalized Extension Outside Shaham

Relatively few advisors who do not belong to the official extension service come in contact with farmers. The Jewish Agency employs horticultural advisors for the new or less developed settlements, for which it is financially responsible. These advisors can also recommend which farmers should get credits or grants for new ventures. A few advisors of the Jewish Agency work also in the regional R&Ds. Usually they coordinate their work with the advisors of Shaham and often participate in joint meetings.

Commercial companies too play a secondary role in the transmission of agricultural knowledge to users. Mainly representatives of firms which supply irrigation equipment, concentrated feedstuff and agrochemicals also visit farmers. They usually try to differentiate between advising and selling, although the commercial goal is clear. While there is nobody in Shaham dealing with irrigation equipment, there are reports on duplications and even competition in the area of feedstuff and of agrochemicals. Usually the agronomists of these commercial firms know how to share their knowledge with Shaham advisers, but occasionally clashes occur.

During the last few years, and especially after Shaham had to cut back its manpower, more private advisers started to appear in the fields. These are mainly specialists in plant protection who are asked to regularly check the fields of farmers or of a whole village, often on a weekly schedule, in order to prescribe the necessary plant protection measures. They are often "graduates" of Shaham and use its knowledge sources. There is a tendency in Shaham to call these plant protection advisers "inspectors" who fulfill a routine job for which

the Shaham advisers have neither time nor inclination, and so to eliminate the feeling of competition which was felt stronger in the past.

4.5 Training

Basic and updating training are important parts of knowledge transmission, especially were suitable training institutions exist. I have already pointed out the historical role which the Miqve Israel agricultural school played in the development of agriculture in the Jewish sector. The Kadoorie agricultural schools in Tulkarem and in Kfar Tabor played a similar role in the Arab sector, though some decades later (See Blum, 1988a).

In the meantime, agricultural schools underwent profound changes. Most of them have become boarding schools for children who need such a school. Only a minority of pupils come to these otherwise regular secondary schools with the intention to learn agriculture. The school farm is still important, but mainly as educational mean, and not so much as vocational training ground. There are still a few who emphasize agriculture as vocation, but they are the minority. Still the educational impact of the agricultural schools is outstanding. Many of them have also become the central secondary school of their region, serving mainly external pupils from Moshavim.

The Kibbutz movement has its own schools. Traditionally they opted for a liberal, humanistic education with extracurricular duties in the children farm, but without teaching agriculture as a subject. They preferrred that youngsters get first practical experience in one of the agricultural branches, being tutored informally by experienced members of the Kibbutz, before they were sent for shorter or longer courses to the Ruppin Study Center. This extraordinary centre was established by the Agricultural Centre and offers a vast array of programmes, from short courses, lasting usually from one to several weeks, to full college courses, leading to a B.Sc. in agricultural economics (with an emphasis on Kibbutz farm management). Many of the courses organized by Shaham advisors are held at the Ruppin Study Centre. It houses also most of the anglophone courses of the Centre for International Agricultural Development Cooperation (CINADCO).

In the vogue of upgrading the professional standards of its members, regional councils, and especially those with a strong Kibbutz influence, set up regional colleges. Studying at a university the subject of his choice has become the privilege of any young Kibbutz member who wishes to do so, and this is well felt at the Faculty of Agriculture. In order to make these studies easier for members of Kibbutzim living in the most northern part of the country, the Regional College of Tel Chai offers courses which are equivalent to the first year at the Faculty of Agriculture, and students can transfer from there into the second year, at Rehovot. These regional colleges also offer non-degree courses in different agricultural and non-agricultural subjects.

Reacting to the need to upgrade and update the agricultural knowledge, the ARO started already some years ago to offer advanced courses. (In the beginning some people were thinking of setting up a second Faculty of Agriculture). More recently, also the Faculty of Agriculture recognized the need to offer non-degree refresher and updating courses, mainly but not exclusively for its alumni.

5. THE KNOWLEDGE POLICY SUBSYSTEM ("Government")

5.1 Research Policy Making and Financing

AKS policy is mainly decided upon by the Committee on Research Goals, often called the Committee of Four, because of its composition - the Director General of the Ministry of Agriculture, its Chief Scientist, its Director of Extension (Shaham) and the Director of the Rural Planning and Development Authority (a joint unit of the Ministry opf Agriculture and the Jewish Agency). This committee, together with four leaders of the Agricultural Center, which represents the farmers, and the Dean of the Faculty of Agriculture form the Supreme Joint Committee on Research and Professional Advancement. It is interesting to note that already at this stage all the partners of the AKS - planning, research, extension and farmers discuss common policy issues in a common forum.

Of course, these committees set only general guidelines and prepare the list of research projects to be funded by the Fund for Priority Research, formerly known as the Director General's Fund, because he has the last word in deciding what will be funded in this way.

Basic costs for permanent manpower and for the upkeep of the Volcani centre and of the ARO regional experimental farms are covered by the Ministry of Agriculture by a basic budget which amounted in 1986-87 to $14,350,000. This ammounts to about 60% of the overall expenditure for agricultural research (Rural Planning and Development Authority, 1988). In 1985 the expenditure for agricultural research was 1.6% of the value of agricultural production, only half of what it had been at the beginning of the decade (Rural Planning and Development Authority, 1987).

While the Ministry of Agriculture pays mainly for the ARO infrastructure, its in-house budget for research projects has become very restricted - $2,161,0 00, of which $1,190,0 00 went to the Fund for Priority Research . The rest of the budget for current research had to come from outside sources - mainly from farmers.

The situation at the Faculty of Agriculture is similar. The very limited in-house research funds are available only for young researchers. Both ARO and university researchers have to compete on outside research funds.

The main financial sources for agricultural research are:

(1) The funds deducted from marketed produce by the commodity production and marketing boards (in short: "the boards") and distributed through the Branch Directorates;
(2) Regional Councils and farmers' organisations;
(3) the U.S.- Israel Binational Agricultural Research and Development Fund (BARD);
(4) the budgets of the R&Ds authorities (for developing regions);
(5) the Fund for Priority Research ; and
(6) smaller sources like the German Israeli Foundation for Scientific R&D (GIF) which is new and caters for many areas, of which agriculture is only

one; and funds earmarked for agricultural research which will benefit developing countries.

In the following paragraphs I shall present more details on some of the most important sources.

In the budget year 1986-87 the main sources of the budgets for current research in Israel were:

Production and Marketing Boards	$4,443,000
Regional councils and farmers' organisations	$3,067,000
BARD's Israeli part	$3,730,000
R&D authorities (89% from the Jewish Agency)	$3,290,000
Fund for Priority Research	$1,190,000

Since the funds of the rural regional councils are also paid by farmers, they actually contribute through different channels $7,510,000 towards research budgets (Agmon, 1987). Thus, farmers pay for 15% of the total cost of agricultural research, including the maintenance of the infrastructure, manpower and project expenditures. This is probably a record figure, worldwide.

The sum of $7,510,000 includes $546,000 for extension, mainly to augment advisors' mobility and to hire some additional advisors. About 60% of the research funds contributed by the farmers come from the 6.25 promille deduction of the added value of marketed agricultural products, 21.5% are paid through regional councils (for regional field trials), 13% come from regional economic organisations of the settlements, and 5.5% from professional organisations.

Due to their general cutback in budgets, regional enterprises had to reduce their research allowances by 40%, compared to the previous year, and regional councils did so by 16%. However, in the 1987/88 budget the contribution by the Jewish Agency rose by 47% and that of the farmers by 35%, while the funds made available by the Ministry of Agriculture and BARD remained more or less the same.

5.1.1 The Production and Marketing Boards and the Branch Directorates

The first of these boards which regulate the production and the marketing of agricultural commodities was set up still under the British rule, for Citrus as the main export product. When the production of other agricultural products surpassed the absorption rate of the local market and exports started, in the 1960s, 11 more boards were set up. Ten of these boards are in the statute book and the Ministers of Agriculture and of Commerce can interfere in the budgets, but in practice leave the affairs to the boards. These boards deduct for research and professional development purposes 6.25 promille of the added (surplus) value of the marketed produce. The distribution of these funds are in the hands of some 30 Branch Directorates. In principle, each branch directorate consists of one third researchers, one third representatives of the Ministry of Agriculture (in practice: Shaham representatives), and one third representatives of the respective growers' associations and other farmer representatives. Usually, the head of Shaham's professional department concerned is chairing the branch directorate. These rules are not always followed to the dot; and some branch directorates are more active than others. In the Citrus Branch Directorate there is quite a strong representation of the large citrus contractor firms, and also in the Flower Branch Directorate the representation of the farmers is more than proportional.

The tripartite composition of the branch directorates, which does not give any sector a majority, forces researchers to take into serious considerations the needs of the farmers. These usually press for quick answers to urgent problems. Researchers, on the other hand, try to explain that they need time and "if you would have funded more basic research on the issue discussed, some years ago, we might have practical solutions today." The better educated farmer representatives are (and especially if they are graduates of the Faculty of Agriculture), the better they can understand the working of agricultural research. In general, branch committees tend to fund short to middle term research projects, which take in account also market pressures.

Branch directorates usually prepare their work through Technical Committees, consisting of three members, one of each sector.

A special problem exists for research which is not concerned with specific commodities, e.g. soil and water problems or plant protection which is not related to specific crops. Therefore research proposals in these areas have little chances to be funded by one of the branch directorates. For these cases Professional Committees exist which are funded by the Ministry. In these committees the representation of farmers is smaller. The activity of these committees depends on the budgets provided. The water committee started to become active the moment it got a budget. Until recently, 4% of the 6.25 promille were put into a special inter-branch research fund, but this has been discontinued. It is assumed that in future farmers' organisations, mainly the Agricultural Centre, will be more active in the promotion of inter-branch research. Quite generally, funding agencies (especially those which are not financed through branch directorates) seem to move more towards preferring inter-branch research projects, in which specialists from different disciplines cooperate, over a number of individual projects which are uncoordinated with others who work on the same problem complex. This is clearly spelt out when research proposals are solicited.

An area which is still without budget is extension research. A joint committee of the extension division of Shaham and the Extension Centre of the Faculty of Agriculture was set up, some years ago, but because it had no budget, it became obsolete, and extension research is still falling between the chairs.

A similar problem exists for new crops for which there is no board and no branch directorate. In some cases, existing directorates or other budget sources can be found. Thus, for instance, the Peanut Production Board agreed to cover also the area of dried medicinal and spice plants, and Agrexco, the governmental export company, set aside money to promote the development of these plant which are to be shipped in fresh condition.

The ARO has a double function. It is mainly a research organisation who has to provide its staff with research funds. It is headed by the Chief Scientist of the Ministry of Agriculture who also heads the service whose task it is to

screen the applications for budgets by researchers from other institutions; and since money is scarce, there is fierce competition.

Research proposals are peer reviewed; but this procedure is problematic where only few specialists exist in each area of research and in a small system in which each one knows the others, and applicants tend to be personal friends or enemies of the reviewer, and in many case his competitors for the funds. Since the reviewing process is handled mainly by a unit belonging to the ARO whose own researchers are also in the competition, it is therefore not surprising that researchers of other institutions have the feeling they are disadvantaged in the process, compared to ARO staff. Out of the research budgets of the Branch Directorates, 48.6% went to ARO and (governmental) Plant Protection and Veterinary Institute, but only 8.7% to the Faculty of Agriculture and other researchers in the Hebrew University - quite a disproportion, if the number of researchers are taken as basis. A large chunk - over 40% - was spent on regional observations and field trials, conducted mainly by extension advisors.

The Chief Scientist's Service handles every year between 1500 and 2000 research applications. These include all projects of the ARO staff, to whatever source of funding they are directed, and all research proposals which expect to be funded by branch directorates (about 500-600 annually), the Fund for Priority Research and the German-Israeli fund for agricultural research cooperation with third world countries.

From April 1989 on, the tasks of Chief Scientist and of ARO Director will be separated. This is expected to solve some of the problems mentioned above.

5.1.2 Regional Councils and Farmers' Organisations

Half of the 54 regional councils appropriated funds for regional field trials ($1,5000,000) and for extension ($300,000). Their contribution sank during the last year by 16%, due to budget restrictions. Mainly the younger councils could not devote any money to research and extension, but councils in regions with strong agriculturally based Kibbutzim, e.g. the Bet Shean rural council, still spent up to $375,000 on regional agricultural research and extension. On the other hand, national professional organisations and especially the

Banana Growers' Association, enlarged their budgets in about the same percentage, but their overall contribution is still not so high ($365,000). Regional, economic enterprises of the Kibbutzim started to become quite important as providers of research means. Their heavy cutback, last year, was due to the economic crisis which affected many Kibbutzim, but they still contributed $690,000 to the overall research budget.

5.1.3 **BARD**

The U.S. Israel Binational Agricultural Research and Development Fund was created by the two governments and started operation in 1979, distributing the annual interests of the fund. So far it has approved over 71 Million Dollars in research budgets. Thus it soon became one of the most important source for agricultural research, mainly for relatively long-term research, which usually last three years. Competition is harsh. Over a ten year period 1,300 applications were submitted, of which about a third could be be funded. The rate of approved projects has fallen during the last years, because the number of applications increased at a time when BARD's funding power decreased because of the weakened dollar, falling interest rates ands rising research costs.

BARD is housed in the ARO headquarters and uses a more elaborate review process which lasts nearly a year. Reviews are solicited in both the U.S. and Israel. The Israeli review side faces the same problems mentioned before.

In the year 1986-87 over 7.6 Million Dollars were distributed, of which about half went to Israel and the other half to the United States (Agmon, 1987). Thus, BARD is not a cover name for US aid. Actually, the amount of funds directed to to US researchers is growing.

The relatively largest portion of the BARD research budgets (19%) goes to Plant Protection. The most neglected area is Agricultural Economics (which includes all other social science aspects of agriculture, for which there seems to be not much understanding).

5.1.4 The Planning and Financing of Field Trials

The budget of the branch directorates covers not only formal research. In 1986/87, 40.4% of the budget was earmarked for 331 regional field trials, conducted to a large part by Shaham advisors. Also input producers like irrigation equipment and agrochemical firms cover expenses for field trials in which they are interested. Many of these field trials are initiated by extension advisors, sometimes inspired by farmers with whom they discussed their problems. As the educational level of farmers rises (and this is the case, with a higher percentage of young farmers receiving university training) - also their initiatives for field trials become more numerous.

Field trials are an important aspect of R&D activities. They contribute much to the professional improvement and to the prestige of the advisors who handle them. Every year about 400-450 field trials are conducted. So far field trials which are based on the priority list of R&D objectives, as set by the policy makers are still in the minority, but their number grows steadily.

As a matter of policy, in each field trial by extension advisors, also researchers and farmers should be partners, but this rule is not yet implemented. Farmers usually contribute the land, on which the field trial is conducted, as well as the irrigation water and the routine agricultural work which the crop needs, according to the research plan. These expenditures for which no cash money is paid are not mentioned in the budget. Thus, the real contribution of farmers to field trials is in reality much higher than the official figures show. In some cases it is estimated to be twice as high.

If everything goes all right, the farmer has the advantage of being the first to have experience with the new technique, variety or whatever was tried out. Only in cases of heavy losses, when something went badly wrong will a compensation be paid.

While formal research proposals which are put before the branch directorates are checked for their scientific and practical value, this is not the case with field trials. The decision to do so or leave it is left to the different branches. In cotton, each field trial has to be accompanied by a researcher of

the ARO or the Faculty of Agriculture; in the other branches this is not necessarily the case. This makes it possible that badly conceived field trials are conducted which lead to wrong conclusions and misinformation. With the computerization of the results of field trials, without further quality check (a procedure which has already started) the danger that counterproductive results are stored and retrieved will grow.

5.2 Planning for the Future

5.2.1 Planning for research

Under the Ministry of Agriculture and the Jewish Agency there is a Rural Planning and Development Authority (RPDA). It prepares five-year plans which are annually revised. The present plan (Rural Planning, 1987) covers the years 1987-91, as "a transition programme for Agriculture in the 2000s". The five year plan assumes that the sophistication of agriculture will continue during the whole last decade of the century, and that genetic engineering and biotechnology will lead to new developments. The economic constraints, in which the country lives and the lack of capital which is expected for the next five years create a gap between the Israeli scientific potential and and the operative ability to exploit this potential. Nevertheless, Israel must take part in this process of sophistication; otherwise it will no longer be able to compete on the agricultural market, by the end of the century. Therefore research and development must receive the highest priority. Higher budget allocations and organisational changes are needed to adapt to the changed situation. According to the five year plan, there is an urgent need to return at least to the same volume of research budgets (in relation to the value of production) which existed at the beinning of the decade.

The main goals for research during the five year plan should be market research abroad (a neglected area), development of new products (based on this market research), especially desert plants, plants which can use low quality water and which allow to grow several crops per year on the same field, organic agriculture, aquaculture and other new ventures. At the same time, research and development should be directed towards improving the efficiency of the use of production means and inputs, the replacement of imported feedstuffs by locally

produced alternatives, and the prolongation of the post-harvest life of products.

The authors of the five year plan complain that most research is initiated by researchers who try to "sell" their topics to funding agencies, including the ARO. Also, farmers want first solutions for burning problems, before financing those concerning the future. To change this situation, a higher governmental research budget is needed. Furthermore, market, planning and economic systems must influence the priorities in the distribution of research funds and only then look for the researchers who are ready to investigate the priority topics. The five year plan asks (in quite vague terms) for a reorganisation of the agricultural research sub-system and a redefinition of the functions of the Chief Scientist and his relation to the ARO. The reconstituted research system should direct funding, also that of farmers, to priority topics, with the future in mind. The five year plan does not contain any concrete suggestions how that should be done.

5.2.2 Planning for extension

The last section in the five year plan is devoted to extension. It emphasizes the need for extension to fulfill the following functions:

- Active participation with researchers in all institutions in the development of new technologies and solutions, mainly through field trials in farmers' fields and with their participation;
- transmission of the research results, the new technologies and solutions as quick as possible to farmers;
- helping well established farmers to move quickly from branch to branch and from one production method to another; and helping new farmers to become established in their existing branches; - creation and direction of professional frameworks of farmers, especially of family farmers, in order to promote their professionalism;
- giving more advice to family farmers on farm management questions (for which most advisors need in-service training and research support).

The last two functions are relatively new to advisors who so far preferred to give individual and agrotechnical advice over organizing groups and advicing on economic topics.

Another neglected field which should receive more attention in the future is the promotion of norms of what was called "agricultural culture". This refers to the need for a clean farm environment, not only out of aesthetic considerations, but also to improve the environmental quality. This facet of farm life is in Israel less developed than in other countries.

The five year plan forsees the need for further development and use of new, computer aided knowledge transmission methods and of group extension methods.

Last but not least comes the need for a reorganization of the extension service, which due to budget cutbacks lost manpower, operational means, scope of activity and much morale.

The RPDA's (1988) economic report emphasizes the need for any new extension organisation to be able to attract professionals of the highest quality and to keep their standards and morale high. Whenever a non-governmental service will be installed, it will be the task of Shaham to make sure that the service will be closely linked with research on the one hand, and with farmers on the other hand. It must continue to play a leading role in the branch directorates which have proven themselves as effective. Thus a strong plea for AKS management is made.

Governmental extension paid for individually by farmers (as in Britain) was discussed and rejected. Where private extension develops, it must be coordinated with the quality service provided so far by extension in order to ensure that farmers will also in future receive advice of the highest quality. However, the most probable solution will be the creation of a public (governmental) company, which will continue the professional tradition of Shaham, but with the farmers' organisations as partners in financing and directing the policy of the new organisation. Having said this, the five year plan recognizes that especially peripheral development areas need also in future special government support. It

can be foreseen (and the discussions between the government and farmers point clearly in this direction) that farmers want also to have more decision making at a regional level, with their active participation in setting priorities.

6. WHAT CAN BE LEARNED FROM THIS ANALYSIS?

As stated in the introductory section, this descriptive analysis of the Israeli AKS is expected to contribute to the understanding of successful agricultural knowledge systems. The generalisations which will follow might well be useful in the planning of new AKS and in the upgrading of existing ones.

6.1 The principal conclusions.

In their analysis of the U.S. extension system, Rogers et al. (1976) have found eight elements which made it successful, and which can be used to analyze other research utilization systems. These are: (1) a critical mass of new technology, (2) a research sub-system oriented to utilization, (3) a high degree of user control over the research utilization process, (4) structural linkages among the research utilization system's components, (5) a high degree of client contact by the linking sub-system, (6) a "spannable" social distance across each interface between components of the system, (7) evolution as a complete system, (8) a high degree of control by the system over its environment.

In the analysis of the Israeli AKS, we can identify all these elements, thus reinforcing the conclusions of Rogers and his colleagues. However, the present analysis highlighted eight further elements which explain the success of the Israeli AKSs. These additional points are the following:

1. Besides the "classical" knowledge generation, knowledge exchange and knowledge utilization subsystems, also knowledge policy is an important component of the AKS.

This review has demonstrated that Israel has special bodies for the formulation of agricultural knowledge policy, and farmers have a distinct input and joint responsibility for bearing the costs. The relatively strong influence which Israeli farmers have over research planning is one of the main reasons for the overall effectiveness of the whole AKS.

2. The different stages of knowledge generation and exchange are coordinated in an interlocked knowledge management system.

Like other man-made systems, also the knowledge system needs careful management for optimalization. This task requires an agreed division of labour and coordination of the institutions, whose staff engage in the generation, transformation and transmission of agricultural knowledge.

3. Knowledge exchange subsystems include more than extension. The media and above all farmers play an important role in the exchange of agricultural knowledge.

Farmers, too, act as important knowledge exchange agents, especially for peers who do not accept the direct advice of extension workers, but do so indirectly, when the same message comes through an experienced farmer. Also the media - in Israel mainly the press - play an important role in the transmission of agricultural knowledge.

4. A good educational level of the users enhances the effectiveness of agricultural knowledge exchange.

The review has shown the importance of a good education as important components of the agricultural knowledge exchange subsystem. Evenson (1982,1986) found that education and extension can be substitutes for each other, at least in industrialized countries. In our case, a synergistic effect seems to exist between the educational standard of farmers and the input of extension into the knowledge exchange subsystem. Farmers' good reading standards and basic agricultural knowledge enables them also to make full use of a well established agricultural press. In developing countries, probably other mass media like radio and television could play a similar role.

5. Informal linkages are as important as the the formal ones.

Much of the success of the AKS in Israel stems from the well functioning interfaces between the knowledge subsystems. Advisors and even farmers are involved in adaptive research, often through informal cooperation. Thus, knowledge exchange through the whole knowledge system becomes smoother.

6. Linkages are especially effective, when the AKS is small or when regionalization is well organized.

In Israel, most researchers and advisors have studied at the same place (at the Faculty of Agriculture, in Rehovot). They often know each other personally or have at least common experiences. They have a similar cultural background. All this helps to encourage and strengthen informal linkages. The small distances for travel enable them to meet more often and more easily than in large systems. Probably, also larger systems can be made more efficient by regionalization and decentralization.

7. Advisors should be professionals.

The more functional (formal and informal) linkages between knowledge subsystems exist, the better the chances that the system as a whole functions well. At the same time, the "actors" in the system must be professionally independent. Researchers, advisors, farmers, educators, the farm press etc. should not unduely be directed by government or other partners in the system. They should be able to act on their best professional judgement. When advisors have an independent and professional status, their credibility among farmers grows.

8. Cooperation is an important facilitating factor which enables the user subsystem to have more influence over the system.

Farmers' active role in influencing the whole AKS is helped by their having strong representative bodies and a high degree of cooperation at all levels.

6.2 What can be adapted to other countries?

This is the more difficult question, especially since little comparative research has been made on AKSs or parts of them. The work of Axinn and Thorat (1972) on specific aspects of AKSs have not been followed up, and more comparative studies are needed. It is probably safe to predict that the principles found by Rogers et al.(1976) and the additional points identified in this study can be demonstrated also in other successful Western AKSs (even in the US, especially if we look at the State level), and that ways can be found to develop weaker AKSs in Western countries by an adaptive development of the weak elements. However, it is more difficult to extrapolate from the analysis of resource rich AKSs in the West to AKSs in low income countries. The next closest

group of AKSs, which could be improved by adapting some of the elements identified, are those which are close to longer and more intensively developed AKSs. These can be traditionally disadvantaged areas in an industrialized country (e.g. less developed mountain areas) or developing countries which are close to a neighbour with a good and adaptable AKS. Arnon & Raviv (1980) and Blum (1988a,b) have shown how this happened in the case of traditional Arab farmers in the Israeli AKS.

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